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ABSTRACT

The problem was to determine the appropriate level of mathematics for an entering student at Chattanooga State Technical Institute to ensure probability of success in his initial course. A multiple regression analysis was used to establish an equation to determine the lower limit of the prediction interval, to determine whether I.Q. or mathematics placement score has more influence on the student's grade, and to determine how much of the variance in grade can be explained by the I.Q. and mathematics placement score. It was concluded that the diagnostic exam was more significant for predicting purposes than the I.Q. score. Linear models were statistically significant as were the individual variables of diagnostic exam and I.Q. score. The explained variance suggested that there was considerable room for improvement in the prediction model. (Author/JM)

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THE DEVELOPMENT OF A PREDICTION MODEL TO DETERMINE THE APPROPRIATE LEVEL OF ENTERING STUDENTS IN MATHEMATICS

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THE DEVELOPMENT OF A PREDICTION MODEL TO DETERMINE THE APPROPRIATE LEVEL OF ENTERING STUDENTS IN MATHEMATICS

A Mini-Grant Research Project
Presented to
The Tennessee Research Coordinating Unit

by
Herbert L. Hooper, Jr.

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ABSTRACT

The problem was to determine the appropriate level for an entering student in mathematics at Chattanooga State Technical Institute to ensure probability of success in his initial course. In addition, an upper prediction interval for Ma-10 and Ma-115 for each entering student and his mathematics placement exam was to be determined so that the student could be properly placed in his initial course.

A multiple regression analysis was used (1) to establish an equation to determine the lower limit of the prediction interval, (2) to determine which of the variables, I. Q. or mathematics placement score, has more of an influence on a student's grade at the Ma-10 or the Ma-115 levels, and (3) to determine how much of the variance in grade can be explained by the I. Q. and mathematics placement exam of a student at the Ma-10 or Ma-115 levels.

It was concluded that the diagnostic exam was more significant for predicting purposes than the I. Q. score. The linear models for Ma-10 and Ma-115 were both statistically significant as were the individual variables of diagnostic exam and I. Q. score for both Ma-10 and Ma-115. Finally, the explained variance suggested that there was considerable room for improvement in the prediction model.

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INTRODUCTION

Chattanooga State Technical Institute is a state-supported, two-year, associate degree-granting institution offering degrees in a variety of engineering and scientific technologies, accounting, and business data processing. High school graduation or the equivalent (GED) diploma is required for admission to C.S.T.I. As a result of these minimum requirements, many students enter the institute with a poor mathematical background.

In order to meet the needs of these students, C.S.T.I. has three levels of entering mathematics. Two of these levels are called pre-technical mathematics, the purpose of which is to prepare the student mathematically to enter the first course, Ma-115, in a degree offering program. The most elementary of these two levels is the Ma-20, Ma-30 sequence. This sequence takes a person whose mathematical background is extremely poor and attempts to prepare him over a two quarter period to enter Ma-115. The other pre-technical mathematics course is Ma-10, which is designed to take a person whose mathematical preparation is better than those who take Ma-20 but not adequate enough to enter Ma-115. Ma-10 attempts to complete in one quarter virtually the same material that is required to complete the Ma-20, Ma-30 sequence in two quarters.

A formerly used standardized test provided no significant correlation between the test score and a student's success in mathematics at either the Ma-10 or Ma-115 levels. As a result the failure rate was high for these courses, averaging about 50% of the enrollment.

Hoping to better place students in their initial mathematics course, the mathematics department designed a thirty-six question multiple-choice diagnostic exam including some of the basic concepts of arithmetic, algebra, and trigonometry. This exam was given the first day of class in Ma-10, Ma-20, and Ma-115 during the fall, winter, and spring quarters of the 1970-71 academic year. Class changes were recommended based on rough guidelines established by the department.

STATEMENT OF THE PROBLEM

Based on the known statistics of the diagnostic exam and the Otis I. Q. score, the problem is to determine the appropriate level for an entering student in mathematics at C.S.T.I. so that the probability of success in his initial mathematics course will be at least 0.7. Success in a course is defined as a C or better, 70% or above. This is accomplished by establishing the lower limit of a 70% prediction interval for a student's grade in Ma-10 and Ma-115.

RATIONALE

Due to the wide range of experiences and mathematical backgrounds of students entering technical schools and technical-divisions of community colleges, it is important to determine the appropriate level of beginning mathematics for the student so that he can successfully build on his mathematical background and experiences. This paper will be concerned with building a statistical model for predicting a student's success in initial mathematics courses at Chattanooga State Technical Institute.

OBJECTIVES

Specifically, the objectives are:

1. To determine the appropriate level for entering students in mathematics at Chattanooga State Technical Institute so his probability of success in his initial course will be high.
2. To determine an upper prediction interval for Ma-10 and Ma-115 for each entering student and his mathematics placement exam so he can be properly placed in his initial course.

METHODOLOGY

At least seventy-five percent of the students who have entered C.S.T.I. did not have ACT scores. These students were required to take a standardized exam and the Otis I. Q. test. Those students in Ma-10 and Ma-115 who had both a diagnostic exam grade and an Otis I. Q. score during the three quarter sequence provide the statistical data for this study.

In order to use a student's diagnostic exam grade and his I. Q. score in the Ma-10 data, Ma-10 must have been his initial mathematics course at C.S.T.I. In a similar manner in order to use a student's statistics for Ma-115, Ma-115 must have been his initial mathematics course at C.S.T.I.

Since the diagnostic test was thought to be the more important of the two variables, diagnostic exam and I. Q., the initial step in the regression analysis was to determine if the diagnostic exam was a statistically significant predictor of a student's grade in Ma-10 and Ma-115. The least squares method for a linear model of the form $Y = B_0 + B_1X_1 + B_2X_2 + \epsilon$ was used in this analysis.

INTERPRETATION OF THE DATA

Analysis of the model, $Y_e = b_o + b_1X_1$ where X_1 is the diagnostic exam score, Y_e is estimated grade, and b_o and b_1 are the estimates of B_o B_1 respectively for Ma - 10:

Number of observations	83
Mean of the responses, Ma - 10 grades	79.67
Standard error of estimate as a per cent of response mean	14.56%
Mean of diagnostic exams, Ma - 10	19.69
Standard deviation of diagnostic exams	3.84
Correlation coefficient	0.4771
Per cent variation explained	22.77

Analysis of Variance

Source	d.f.	S.S.	MS	F
Total (corrected)	82	14,114.22		
Regression (b_1)	1	3,213.91	3,213.91	23.88
Residual	81	10,900.30	134.57	

Since F (1,81,0.95) = 3.97, the diagnostic exam is statistically significant, i.e., 23.88 > 3.97.

Analysis of the model, $Y = b_o + b_1X_1$ where X_1 is the diagnostic exam score, Y_e is the corresponding estimated grade in Ma - 115 and b_o and b_1 are the estimates of B_o and B_1 respectively:

Number of observations	54
Mean of the responses, Ma - 115 grades	79.80

Standard error of estimate as a per cent of response mean	14.06%
Mean of diagnostic exams, Ma - 115	27.76
Standard deviation of diagnostic exams	4.03
Correlation coefficient	0.5153
Per cent variation explained	26.56

Analysis of Variance

Source	d.f.	S.S.	MS	F
Total (corrected)	53	8,908.76		
Regression	1	2,366.03	2,366.03	18.80
Residual	52	6,542.76	125.82	

Since $F(1,52,0.95) = 4.04$, the diagnostic exam is statistically significant for predicting the Ma - 115 grade, i.e., $18.80 > 4.04$.

The second step in the multiple regression analysis was to determine if I.Q. was a statistically significant predictor of a student's grade in Ma - 10 and Ma - 115.

Analysis of the model, $Y_e = b_o + b_1X_1$ where X_1 is the I.Q. score, Y_e is the corresponding grade in Ma - 10, and b_o and b_1 are the estimates of B_o and B_1 respectively:

Number of observations	83
Mean of the responses, Ma - 10 grades	79.67
Standard error of estimate as a per cent of response mean	15.44%
Mean of I.Q. scores, Ma - 115	105.05
Standard deviation of I.Q. scores	9.444
Correlation coefficient	0.3627
Per cent variation explained	13.15

Analysis of Variance

Source	d.f.	S.S.	MS	F
Total (corrected)	82	14,114.22		
Regression	1	1,856.62	1856.62	12.27
Residual	81	12,257.60	151.33	

Since F(1,81,0.95) = 3.97, the I.Q. score is statistically significant for predicting Ma - 10 grades, i.e., 12.27 > 3.97.

Analysis of the model, $Y_e = b_o + b_1X_1$ where X_1 is the I.Q. score, Y_o is the corresponding grade in Ma - 115, and b_o and b_1 are the estimates of B_o and B_1 respectively:

Number of observations	54
Mean of the responses, Ma - 115 grades	79.80
Standard error of estimate as a per cent of response mean	15.16%
Mean of I.Q. scores, Ma - 115	111.56
Standard deviation of I.Q. scores, Ma - 115	9.99
Correlation coefficient	0.3819
Per cent variation explained	14.59

Analysis of Variance

Source	d.f.	S.S.	MS	F
Total (corrected)	53	8,908.80		
Regression	1	1,299.36	1,299.36	8.88
Residual	52	7,609.43	146.34	

Since F(1,52,0.95) = 4.04, the I.Q. score is statistically significant for predicting Ma - 115, i.e., 8.88 > 4.04.

At this point the model was expanded to include both variables, diagnostic exam grade and I.Q. score, for Ma - 10 and Ma - 115.

Analysis of the model, $Y_c = b_o + b_1X_1 + b_2X_2$ where X_1 is the diagnostic exam grade, X_2 is the I.Q. score, Y_c is the corresponding grade in Ma - 10, and b_o, b_1, and b_2 are the estimates of B_1, B_2, and B_3 respectively:

Number of observations	83
Mean of the responses, Ma - 10 grades	79.67
Standard error of estimate as a per cent of response mean	14.04%
Per cent variation explained	29.08
Prediction equation	$Y_c = 14.09 + 1.41X_1 + 0.36X_2$
Standard deviation of residuals	11.05

Analysis of Variance

Source	d.f.	S.S.	MS	F
Total (corrected)	82	14,114.22		
Due to Regression	2	4,104.21	2,052.11	16.40[a]
due to b_1	1	3,213.97	3,213.97	25.69[a]
due to b_2 given b_1	1	890.24	890.24	7.12[a]
due to b_2	1	1,856.47	1,856.47	14.84[a]
due to b_1 given b_2	1	2,247.75	2,247.75	17.96[a]
Residual	80	10,010.00	125.125	

[a]Significant at the 0.05 level.

As indicated from the table the linear model $Y_c = b_o + b_1X_1 + b_2X_2$ is statistically significant as is b_1 and b_2 given b_1. Also, as shown above, b_2 and b_1 given b_2 are statistically significant.

For a one standard deviation change in the diagnostic exam grade the grade in Ma - 10 would change 0.412 standard deviations; whereas, a one standard deviation change in I.Q. score resulted in a 0.259 standard deviation change in the Ma - 10 grade.

In order to use the F-tests for significance, the distribution of the residuals must be such that there is no reason to doubt that the residuals are normally distributed. As indicated by an examination of the analysis of residuals table for Ma - 10 (Appendix A), there is no reason to doubt this assumption of normality for the residuals. Also, the residuals have an approximate mean of zero and a standard deviation of 11.05.

Analysis of the model, $Y_e = b_o + b_1X_1 + b_2X_2$ where X_1 is the diagnostic exam grade, X_2 is the I.Q. score, Y_e is the corresponding grade in Ma - 115, and b_o, b_1, and b_2 are the estimates of B_1, B_2, and B_3 respectively:

Number of observations	54
Mean of the responses, Ma - 115 grades	79.80
Standard error of estimate as a per cent of response mean	13.59%
Per cent variation explained	32.69
Prediction equation	$Y_e = 3.29 + 1.43X_1 + 0.33X_2$
Standard deviation of residuals	10.64

Analysis of Variance

Source	d.f.	S.S.	MS	
Total (corrected)	53	8,908.76		
Due to Regression	2	2,912.56	1,456.28	12.39[b]
due to b_1	1	2,366.03	2,366.0325	20.12[b]
due to b_2 given b_1	1	546.53	546.5284	4.65[b]
due to b_2	1	1,299.36	1,299.3634	11.05[b]
due to b_1 given b_2	1	1,613.20	1,613.1975	13.72[b]
Residual	51	5,996.20	117.5725	

[b]Significant at the 0.05 level.

As indicated the linear model $Y_e = b_o + b_1X_1 + b_2X_2$ is statistically significant as is b_1 and b_2 given b_1. Also, as shown above, b_2 and b_1 given b_2 are statistically significant.

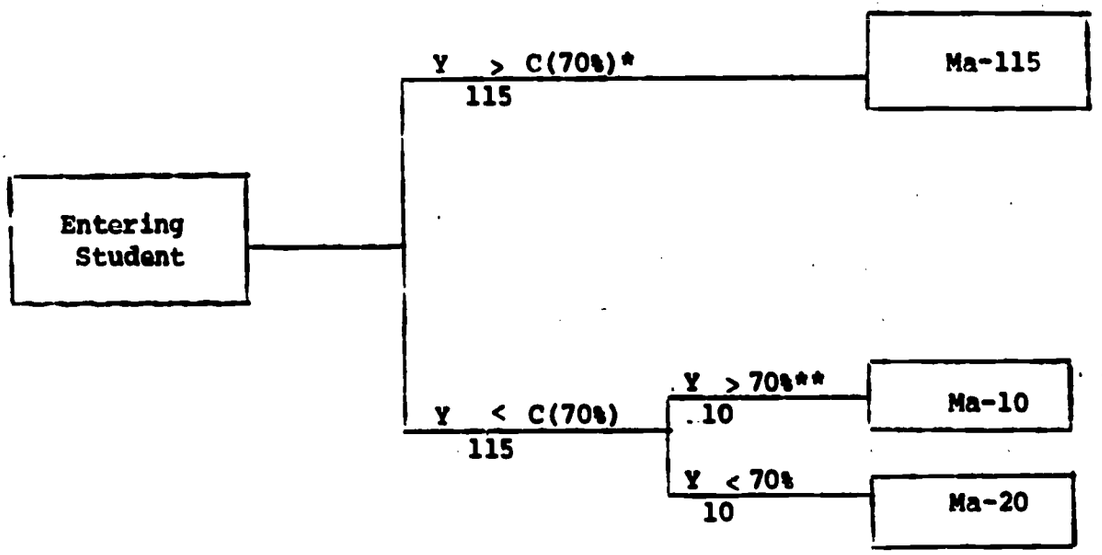
For a one standard deviation change in the diagnostic exam grade, the grade in Ma - 115 would change 0.443 standard deviation; whereas, a one standard deviation change in I.Q. score would result in a 0.258 standard deviation change in the Ma - 10 grade.

On examination of the table of residuals for Ma - 115 (Appendix B), the assumption of normality does not appear to be violated. Again, the approximate mean of the residuals is zero with a standard deviation 10.6365.

In order to place a student in his initial mathematics course, the lower limit of a 70% prediction interval is used. For a student with a given diagnostic exam grade and a given I.Q. to enter Ma - 10 or Ma - 115, he must have a probability of at least 0.7 of making at least a C, i.e.; a grade of 70%. The lower limit of a 70% prediction interval provides the necessary information for placement. A sample of the 70% prediction intervals for Ma - 10 and Ma - 115 is given in Appendix C.

The procedure for placing a student in their initial mathematics course at C.S.T.I. is illustrated by the following diagram:

Placement in Initial Mathematics
Course at C.S.T.I.



* Y_{115} = Lower limit of a one-sided 70% prediction interval for Ma-115

** Y_{10} = Lower limit of a one-sided 70% prediction interval for Ma-10

CONCLUSIONS

1. Since the diagnostic exam accounts for a greater standard deviation change in both the Ma - 10 grade and the Ma - 115 grade than does I.Q., the diagnostic exam is more significant for predicting purposes than the I.Q. score.
2. As indicated by the analysis of variance table for Ma - 10, the linear model $Y_e = 14.0891 + 1.41X_1 + 0.36X_2$ is statistically significant. However, with an explained variance of only 29.08% and the standard error of estimate as a percent of the mean grade for Ma - 10 of 14.14%, there is considerable room for improvement in the prediction model.
3. For Ma - 115, the prediction model $Y_e = 3.29 + 1.43X_1 + 0.33X_2$ is statistically significant as are the individual variables of diagnostic test and I.Q. With an explained variance of only

32.69% and the standard error of estimate as a per cent of mean grade of 13.59%, there is room for much improvement in the prediction model.

RECOMMENDATIONS

1. In order to improve the explained variance, additional variables such as high school grade point average, high school mathematics grade point average, number of working hours per week while taking Ma - 10 or Ma - 115, etc.; need to be examined for possible use in the prediction equation.
2. Standardization of testing and grading between teachers for the Ma - 10 and Ma - 115 courses should improve the statistical model as a predictor.

APPENDICES

APPENDIX A

RESIDUAL ANALYSIS FOR MA - 10

Number	Observed Grade	Predicted Grade	Residual	Normal Deviate
1	83	90.74	7.74	0.69
2	73	73.75	0.75	0.07
3	100	84.36	-15.64	-1.40
4	73	63.03	-9.97	-0.89
5	66	82.34	16.34	1.46
6	90	89.91	-0.09	-0.01
7	77	77.25	0.25	0.02
8	71	78.98	7.98	0.71
9	99	85.37	-13.64	-1.22
10	75	90.10	15.10	1.35
11	76	87.42	11.42	1.02
12	90	78.73	-11.27	-1.01
13	83	76.96	-6.04	-0.54
14	38	75.77	-12.23	-1.09
15	77	81.79	4.79	0.43
16	97	93.23	-3.77	-0.34
17	76	82.91	6.91	0.62
18	80	78.33	-1.67	-0.15
19	81	74.15	-6.85	-0.61
20	55	68.48	13.48	1.21
21	90	74.04	-15.97	-1.43
22	99	95.76	-3.24	-0.29
23	87	88.58	1.58	0.14
24	92	81.94	-10.06	-0.90
25	69	74.22	5.22	0.47
26	88	81.51	-6.50	-0.58
27	95	83.27	-11.73	-1.05
28	83	69.70	-13.30	-1.19
29	67	79.70	12.70	1.1354
30	78	82.51	4.51	0.40
31	81	82.88	1.88	0.17

Number	Observed Grade	Predicted Grade	Residual	Normal Deviate
32	82	85.51	3.51	0.31
33	93	84.28	-8.72	-0.78
34	79	82.26	3.26	0.29
35	97	86.20	-10.80	-0.97
36	91	86.52	-4.48	-0.40
37	93	92.51	-0.49	-0.04
38	52	70.18	18.18	1.63
39	62	77.32	15.32	1.37
40	59	73.86	14.86	1.33
41	91	81.47	-9.53	-0.85
42	65	72.55	7.55	0.68
43	84	72.67	-11.34	-1.01
44	85	71.51	-13.49	-1.21
45	75	74.43	-0.57	-0.05
46	92	69.09	-22.91	-2.05
47	65	77.25	12.25	1.10
48	82	68.44	-13.56	-1.21
49	67	81.54	14.54	1.30
50	79	80.14	1.14	0.10
51	57	81.54	24.54	2.19
52	90	88.90	-1.10	-0.10
53	34	62.74	28.74	2.57
54	81	79.05	-1.95	-0.17
55	77	67.69	-9.32	-0.83
56	52	65.41	13.41	1.20
57	89	87.82	-1.18	-0.11
58	95	81.58	-13.42	-1.20
59	74	72.74	-1.26	-0.11
50	83	70.73	-4.27	-0.38
61	82	82.23	0.23	0.02
62	42	65.48	23.48	2.10
63	73	80.82	7.82	0.70
64	69	77.97	8.97	0.80

Number	Observed Grade	Predicted Grade	Residual	Normal Deviate
65	80	79.99	-0.01	-0.00
66	78	73.03	-4.97	-0.45
67	93	80.46	-12.54	-1.12
68	79	80.14	1.14	0.10
69	89	74.47	-14.53	-1.30
70	89	79.02	-9.99	-0.89
71	94	75.27	-18.73	-1.68
72	78	82.88	4.88	0.44
73	88	84.39	-3.61	-0.32
74	68	81.94	13.94	1.25
75	77	85.08	8.08	0.72
76	65	80.02	15.02	1.34
77	81	90.10	9.10	0.81
78	80	74.54	-5.46	-0.49
79	92	90.10	-1.91	-0.17
80	97	82.26	-14.74	-1.32
81	91	81.79	-9.21	-0.82
82	91	83.31	-7.69	-0.69
83	73	86.12	13.12	1.17

APPENDIX B

RESIDUAL ANALYSIS FOR MA - 115

Number	Observed Grade	Predicted Grade	Residual	Normal Deviate
1	89	74.26	-14.74	-1.36
2	88	83.32	-4.68	-0.43
3	62	83.06	21.08	1.94
4	87	99.08	12.08	1.11
5	75	73.75	-1.25	-0.12
6	84	76.02	-7.98	-0.74
7	75	83.81	8.81	0.81
8	82	81.96	-0.04	-0.00
9	70	82.30	12.30	1.13
10	96	88.68	-7.32	-0.68
11	79	81.46	2.46	0.23
12	86	78.44	-7.56	-0.70
13	79	86.58	7.58	0.70
14	66	81.12	15.12	1.39
15	90	87.92	-2.08	-0.19
16	68	73.07	5.07	0.47
17	89	90.86	1.86	0.17
18	70	77.36	7.36	0.68
19	77	87.25	10.25	0.95
20	67	72.48	5.48	0.51
21	68	83.14	15.14	1.40
22	61	67.36	6.36	0.59
23	75	67.53	-7.47	-0.69
24	45	67.37	22.37	2.06
25	92	84.73	-7.27	-0.67
26	74	71.65	-2.34	-0.22
27	85	81.13	-3.87	-0.36
28	83	81.80	-1.20	-0.11
29	78	84.15	6.15	0.57
30	68	83.99	15.99	1.47

Number	Observed Grade	Predicted Grade	Residual	Normal Deviate
31	90	83.23	-6.77	-0.62
32	83	77.61	-5.39	-0.50
33	88	87.25	-0.75	-0.07
34	81	88.26	7.26	0.67
35	84	81.47	-2.53	-0.23
36	92	85.24	-6.76	-0.62
37	70	77.60	7.60	0.70
38	93	80.04	-12.96	-1.20
39	97	78.27	18.73	-1.73
40	93	88.76	-4.24	-0.39
41	86	79.20	-6.80	-0.63
42	90	78.12	-11.88	-1.10
43	70	82.14	12.14	1.12
44	26	56.06	30.06	2.77
45	83	67.62	-15.38	-1.42
46	95	80.61	-14.39	-1.33
47	92	82.14	-9.86	-0.91
48	94	87.34	-6.66	-0.62
49	80	70.05	-9.95	-0.92
50	76	67.53	-8.47	-0.78
51	84	80.96	-3.04	-0.28
52	84	81.88	-2.12	-0.20
53	77	75.43	-1.58	-0.15
54	93	76.60	-16.40	-1.51

APPENDIX C

SEVENTY PER CENT PREDICTION INTERVALS

Diagnostic Test	I.Q.	Ma-115 70% Level	Ma-10 70% Level
17	95	54.210 < Ma 115	66.287 < Ma 10
17	96	54.556 < Ma 115	66.665 < Ma 10
17	97	54.899 < Ma 115	67.021 < Ma 10
17	98	55.242 < Ma 115	67.387 < Ma 10
17	99	55.583 < Ma 115	67.752 < Ma 10
17	100	55.923 < Ma 115	68.116 < Ma 10
17	101	56.262 < Ma 115	68.479 < Ma 10
17	102	56.599 < Ma 115	68.841 < Ma 10
17	103	56.935 < Ma 115	69.202 < Ma 10
17	104	57.270 < Ma 115	69.563 < Ma 10
17	105	57.604 < Ma 115	69.922 < Ma 10
17	106	57.936 < Ma 115	70.281 < Ma 10
17	107	58.267 < Ma 115	70.639 < Ma 10
17	108	58.596 < Ma 115	70.996 < Ma 10
17	109	58.924 < Ma 115	71.352 < Ma 10
17	110	59.251 < Ma 115	71.708 < Ma 10
17	111	59.577 < Ma 115	72.062 < Ma 10
17	112	59.901 < Ma 115	72.416 < Ma 10
17	113	60.225 < Ma 115	72.769 < Ma 10
17	114	60.546 < Ma 115	73.121 < Ma 10
17	115	60.867 < Ma 115	73.472 < Ma 10
17	116	61.186 < Ma 115	73.823 < Ma 10
17	117	61.505 < Ma 115	74.172 < Ma 10
17	118	61.822 < Ma 115	74.521 < Ma 10
17	119	62.137 < Ma 115	74.869 < Ma 10
17	120	62.452 < Ma 115	75.216 < Ma 10
18	95	55.649 < Ma 115	67.700 < Ma 10
18	96	55.995 < Ma 115	68.068 < Ma 10
18	97	56.340 < Ma 115	68.435 < Ma 10
18	98	56.683 < Ma 115	68.801 < Ma 10

Diagnostic Test	I.Q.	Ma-115 70% Level	Ma-10 70% Level
18	99	57.026 < Ma 115	69.167 < Ma 10
18	100	57.366 < Ma 115	69.531 < Ma 10
18	101	57.706 < Ma 115	69.895 < Ma 10
18	102	58.044 < Ma 115	70.258 < Ma 10
18	103	58.381 < Ma 115	70.619 < Ma 10
18	104	58.717 < Ma 115	70.980 < Ma 10
18	105	59.051 < Ma 115	71.341 < Ma 10
18	106	59.384 < Ma 115	71.700 < Ma 10
18	107	59.715 < Ma 115	72.058 < Ma 10
18	108	60.046 < Ma 115	72.416 < Ma 10
18	109	60.375 < Ma 115	72.773 < Ma 10
18	110	60.702 < Ma 115	73.129 < Ma 10
18	111	61.029 < Ma 115	73.484 < Ma 10
18	112	61.354 < Ma 115	73.838 < Ma 10
18	113	61.678 < Ma 115	74.191 < Ma 10
18	114	62.001 < Ma 115	74.544 < Ma 10
18	115	62.322 < Ma 115	74.896 < Ma 10
18	116	62.642 < Ma 115	75.247 < Ma 10
18	117	62.961 < Ma 115	75.597 < Ma 10
18	118	63.279 < Ma 115	75.946 < Ma 10
18	119	63.595 < Ma 115	76.294 < Ma 10
18	120	63.910 < Ma 115	76.642 < Ma 10
.	.	.	.
.	.	.	.
.	.	.	.
25	95	65.507 < Ma 115	77.449 < Ma 10
25	96	65.858 < Ma 115	77.820 < Ma 10
.	.	.	.
.	.	.	.
.	.	.	.
25	119	73.584 < Ma 115	86.129 < Ma 10
25	120	73.905 < Ma 115	86.481 < Ma 10

Diagnostic Test	I.Q.	Ma-115 70% Level	Ma-10 70% Level
26	95	66.886 Ma 115	78.821 Ma 10
26	96	67.237 Ma 115	79.193 Ma 10
.	.	.	.
.	.	.	.
.	.	.	.
26	119	74.981 < Ma 115	87.514 < Ma 10
26	120	75.303 < Ma 115	87.866 < Ma 10
27	95	68.257 < Ma 115	80.189 < Ma 10
27	96	68.609 < Ma 115	80.561 < Ma 10
27	97	68.960 < Ma 115	80.933 < Ma 10
27	98	69.310 < Ma 115	81.303 < Ma 10
27	99	69.659 < Ma 115	81.673 < Ma 10
27	100	70.006 < Ma 115	82.042 < Ma 10
27	101	70.352 < Ma 115	82.410 < Ma 10
27	102	70.697 < Ma 115	82.778 < Ma 10
27	103	71.041 < Ma 115	83.144 < Ma 10
27	104	71.384 < Ma 115	83.510 < Ma 10
27	105	71.725 < Ma 115	83.874 < Ma 10
27	106	72.065 < Ma 115	84.238 < Ma 10
27	107	72.404 < Ma 115	84.602 < Ma 10
27	108	72.741 < Ma 115	84.964 < Ma 10
27	109	73.077 < Ma 115	85.325 < Ma 10
27	110	73.412 < Ma 115	85.686 < Ma 10
27	111	73.746 < Ma 115	86.046 < Ma 10
27	112	74.078 < Ma 115	86.405 < Ma 10
27	113	74.409 < Ma 115	86.763 < Ma 10
27	114	74.739 < Ma 115	87.120 < Ma 10
27	115	75.068 < Ma 115	87.477 < Ma 10
27	116	75.395 < Ma 115	87.832 < Ma 10
27	117	75.722 < Ma 115	88.187 < Ma 10
27	118	76.047 < Ma 115	88.541 < Ma 10
27	119	76.370 < Ma 115	88.894 < Ma 10
27	120	76.693 < Ma 115	89.247 < Ma 10

APPENDIX D

September 17, 1971

Mr. Robert U. Coker
Regional Research & Development
Coordinator
Research Coordinating Unit
2020 Terrace Avenue
Knoxville, Tennessee 37916

Dear Mr. Coker:

The enclosed document constitutes an effort to develop a prediction model to determine the appropriate level of entering students in mathematics at the Chattanooga State Technical Institute. I hope this study is satisfactory.

The following expenses or obligations were incurred:

Total $370.00

If there are any questions regarding this matter, please let me know.

Sincerely,

Herbert L. Hooper, Jr.
Assistant Professor of
Mathematics